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Stellar Pyrotechnics: Nucleosynthesis in Classical Nova Explosions

Classical novae are thermonuclear explosions that take place in the envelopes of accreting white dwarfs in stellar binary systems. The material piles up under degenerate conditions, driving a thermonuclear runaway. The energy released by the suite of nuclear processes operating at the envelope heats the material up to peak temperatures of (100 - 400) MK. During these events, about 10^{-3} - 10^{-7} solar masses, enriched in CNO and, sometimes, other intermediate-mass elements (e.g., Ne, Na, Mg, Al) are ejected into the interstellar medium.
This Century has witnessed an extraordinary progress in our understanding of the physics that govern classical nova explosions. Indeed, new tools and developments, at the crossroads of theoretical and computational astrophysics, observational astronomy, cosmochemistry, and nuclear physics, have revolutionized our view of such stellar beacons. The use of space-borne observatories has allowed a novel panchromatic view of nova explosions. In parallel to the elemental abundances inferred spectroscopically from the nova ejecta (almost in real time), cosmochemists can now provide isotopic abundance ratios from micron-sized presolar nova grains extracted from meteorites. Encapsulated in those grains is pristine information about the suite of nuclear processes that took place in their stellar progenitors in epochs that predate the Solar System itself. The dawn of supercomputing has provided astrophysicists with the appropriate arena to study complex physical phenomena, such as convective mixing during novae, that unavoidably require a multidimensional approach. Last but not least, nuclear physicists have developed new techniques to determine nuclear interactions close to nova energies.
In this talk, I will provide a multidisciplinary overview of nova nucleosynthesis, with emphasis on the role played by current nuclear uncertainties.

Primary author: Prof. JOSE, Jordi (UPC Barcelona)

Presenter: Prof. JOSE, Jordi (UPC Barcelona)